

PATENT SPECIFICATION (11)

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(54) A FILTERING APPARATUS FOR SEPARATING SOLID PARTICLES FROM GASES

(71) I, BILL PETER PHILIP NEDERMAN, of Swedish nationality, of Halalid 3, S-252 33 Helsingborg, Sweden, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a filtering apparatus for separating solid particles from gases, preferably welding gases, the apparatus comprising at least one filter unit disposed between end-wall units and including at least one filter element, and at least one power unit, preferably a suction fan, adapted to draw a gas-flow through the filter element of the filter unit.

In the use of apparatus of the type indicated above, it is usually desired on one hand, to separate sparks and heavier particles to prevent their penetration into the filter unit and causing ignition thereof, and on the other hand, to enable the use of filter elements which can be heavily loaded and also offer a large filter area, and, thirdly, to enable the employment of a high-capacity power unit, and fourthly, to enable the power unit to be disposed in a manner to muffle its noise substantially.

Although prior art devices, to a certain extent, have been devised to fulfil the functions aimed at, it has been found, that the apparatus tends to be more complicated and costly, larger and more unwieldy and difficult of assembly and disassembly, and more extensively equipped it is in order to fulfil the functions aimed at.

The present invention has for its object to provide an apparatus for separating solid particles from gases, which apparatus efficiently fulfils various desired functions while utilizing a small number of simple parts, which is robust, easy to assembly and disassembly and enables the provision of a portable unit available at low cost. This, according to the present invention, is enabled substantially by the fact that the filter unit comprises a filter container connecting and releasable from the end-wall units, said filter container having open ends and

long sides closed by an inner wall and an outer wall whereby said walls together define a filter compartment for the filter element, said inner wall further defines an interior compartment containing the power unit and said outer wall further forms a casing detachably connected to both the end-wall units, and wherein the filter compartment communicates through one of its open ends with one end-wall unit designed as a gas-inlet unit and communicates through its other open end and said inner compartment containing the power unit with the opposite end-wall unit designed as a gas-outlet unit.

As a consequence of these features there will be defined, i.e. by a small number of elements, a space or compartment for receiving the power unit whereby the filter unit, in addition to its characteristic filtering properties, has sound-insulating properties to muffle the noise from the fan and can be conveniently disassembled and re-assembled for replacing a contaminated filter unit by a fresh one. Furthermore, the filter unit and the end-wall units impart to the apparatus a compact form without making the apparatus too heavy to be carried about.

The invention will now be described more in detail with reference to the accompanying drawings, in which:—

Figure 1 illustrates the apparatus according to the invention with its main components shown in cross-sectional view; and

Figure 2 illustrates a portion of a filter forming part of the apparatus.

The apparatus illustrated in the drawings is adapted for use in separating solid particles from gases, preferably welding gases, and comprises, on one hand, at least one filter unit 1 including at least one filter element 6, and, on the other hand, at least one power unit 5, preferably an electrically driven suction fan which is adapted to draw a flow of gas through the filter element 6 of filter unit 1.

In order, in this arrangement, to ensure efficient spark arresting and noise reduction, a durable filter having highly effi-

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cient filtering properties, as well as convenient assembly and disassembly of a small number of light weight and dismountable parts, the power unit 5, according to the present invention, is disposed within a space or compartment 2 defined, on one hand, by the filter unit 1, and, on the other hand, by two end-wall units 3 and 4 which one end-wall unit 3 constitutes a gas-inlet through which a flow of gas enters the filter unit 1 to be conducted therein so as to pass through said filter element 6, whereas the other end-wall unit 4 constitutes a gas-outlet unit through which gas leaves the apparatus.

In order to construct the filter unit 1 as a sturdy and easily interchangeable unit adapted to withstand internal and external pressure loadings, it is constituted as a separate unit comprising at least one space or compartment 9 defined between an inner cylindrical wall 7 and an outer cylindrical wall 8 and within which the filter element 6 is disposed.

To the end of making this filter unit an interchangeable unit defining the peripheral outer and inner walls of the apparatus and to which the end-wall units 3 and 4 are directly connectable and after connection will have their interior spaces communicating with the interior of the filter unit 1, the arrangement is so devised that the inner cylindrical wall 7 constitutes one wall of the space 2 containing the power unit 5, the outer cylindrical wall 8 constituting an outer wall of the apparatus extending between the end-wall units 3 and 4, and the ends of the space 9 defined by the walls 7, 8 enclosing the filter element 6 are open.

The end-wall unit 3 forming the gas-inlet unit may include an annular passage 10 into which at least one gas-supply conduit 11 opens, this gas-supply conduit 11 preferably being connected to the end-wall unit 3 by a quick-coupling and adapted to direct the gas-flow in a manner to cause the latter when flowing through the passage 10 in one direction to rotate so as to create a cyclone effect.

In order to provide simple means for effectively preventing spark transfer to the filter unit 1, the annular passage 10 extends beneath the space 9 containing the filter element 6 of the filter unit 1 and is separated from this space 9 by a partition 13 which is provided with through-flow apertures 12 and preferably made as a separate unit.

In order, in a simple way, to ensure sealing between the end-wall unit 3 and filter unit 1, at least one sealing element 14 of a sealing material, preferably rubber, may be superposed on the partition member 13, the cylindrical wall 7 of the filter unit 1 forming a wall of the space 2 sealingly

engaging said sealing element 14 to cause a sealed-off communication passageway between the inner cylindrical wall 7 of the filter unit 1 defining the space 2 and the end-wall unit 3 constituting the inlet-unit of the apparatus.

To the end of enabling quick assembly of the filter unit 1 and end-wall unit 3 while ensuring efficient sealing action, the end-wall unit 3 constituting the inlet unit includes an outer peripheral edge portion or rim 15 adapted, on one hand, to form a catch or socket for holding an annular sealing element 16 of a sealing material sealingly engaged by the outer cylindrical wall 8 of the filter unit 1, and, on the other hand, to form a guiding edge for said outer wall 8.

The guiding of the outer cylindrical wall 8 of the filter unit in connection with assembly of the filter unit 1 and end-wall unit 3 can be further improved by forming the partition member 13 with an outer peripheral edge portion or rim 17 engaging the sealing element 16 and defining with the guiding edge portion 15 an annular recess of clearance into which the outer edge of wall 8 projects.

In the embodiment illustrated, a thin-walled but very rigid end-wall construction is provided owing to the fact that a wall-element 18 forming part of the end-wall unit 3 constituting the inlet section, on one hand, defines the annular passage 10, and, on the other hand, forms the edge portion 15 outside this passage 10, and, further, inside the passage 10 comprises a wall portion 19 which directly or indirectly defines the space 2.

The power unit 5 may be mounted on both end-wall units 3 and 4, being connected to the inlet end-wall unit 3 by at least one clamp screw 20, which can be unscrewed to enable the filter unit 1 to be disconnected from the outlet end-wall 4 and the power unit 5, as well as from the inlet end-wall 3.

In order, for the purpose of cooling and noise-muffling, to cause the cleaned air to sweep the entire power unit, the latter has a casing 21 defining with the filter unit 1a through flow space 22 extending along the major portion of the length of the filter unit 1 and communicating at one end thereof with the space 9 containing the filter element 6 of filter unit 1, and at the opposite end thereof with the power unit 5 through at least one inlet opening 23 in the casing 21.

To enable the apparatus according to the invention to be used in operation as a warming stool, the outlet end-wall unit 4 comprises a seat 24 having beneath the same a space 25 receiving heated gas flowing upward from the power unit 5, said space

25 being open to the exterior beneath an outer edge portion 26 of the seat 24.

The end-wall unit 4 may have associated therewith a carrier 27 for the power unit 5, this carrier 27 being formed with a protective collar 28 adapted to prevent any water or other fluids or objects penetrating in beneath the seat 24 from proceeding further and enter outlet openings and pass therethrough down to the power unit 5. The carrier 7 may suitably form an attachment for at least one control 29 for manually controlling the power unit 5, and/or an attachment for an operating switch 30 for automatically switching the power unit 5 in and out.

In order to retain the filter unit 1 in a fixed position within the apparatus without necessitating any use of parts creating a high level of air resistance, the end-wall unit 4 includes an end-wall 31 spaced from the filter unit 1 by at least one spacer element 32, preferably in the form of a grid, which is adapted to prevent any displacement of the filter element 6 in the gas-flow direction, but to allow gas-flow from the space 9 of the filter unit 1 to the space 2 containing the power unit 5. The end-wall 31 preferably has an outer peripheral edge portion or rim 33 which, on one hand, forms a catch for retaining a sealing element 34 of a sealing material sealingly engaged by the outer cylindrical wall 8 of the filter unit 1, and, on the other hand, forms a guiding edge for the outer wall 8.

To enable access to the power unit by separating one end-wall unit 4 from the filter unit 1, the apparatus is so designed that the power unit 5 and/or an outer casing 21 (if any) enclosing the power unit 5 is detachably associated with the outlet end-wall unit 4.

To provide a filter element having fan-noise muffling properties, high particle separation capacity and high stability, the filter element comprises superposed layers 36, 37 (Fig. 2) defining with each other elongated passageways 38, 39, the juxtaposed layers extending helically about the inner cylindrical wall 7 in a manner to enable gas coming from the inlet end-wall unit 3 to flow through the passageways 38, 39 towards the outlet end-wall unit 4 and leave the filter element 6 after having passed through the filter layers.

The filter element 6 will have particularly long service life, high particle separating capacity, and, in addition high durability against both internal and external pressure loading, if at least one of the fibrous material layers 37 divides a space between filter-material layers 36 disposed at both sides thereof into inflow passageways 38 having substantially larger cross-sectional areas than those of the outflow passageways

39, so as to form at least one inflow-passageway system having essentially larger through-flow than that of the outflow-passageway system, whereby solid particles separated from the gas can be stored within the inflow-passageway system without the through-flow area of the latter getting smaller than that of the out-flow passageway system.

In order to utilize the space between the fibrous material layers in a particularly effective way as regards particle collection, and also to establish a durable filter pack, the intervening fibrous-material layer 37 is designed to define inflow passageways 38 of a cross-sectional shape essentially different from that of the outflow passageways 39.

To form the intervening fibrous-material layer 37 to provide a large number of juxtaposed stiffening portions, said layer 37 is so shaped as to form corners or apices engaging one adjacent fibrous-material layer 36, and arcuate portions extending between each couple of adjacent apices and engaging the other adjacent fibrous-material layer 36, each arcuate portion inter-connecting two apices defining with said first-mentioned adjacent fibrous-material layer an inflow passageway 38.

From the points of view of stability and particle collection, particularly good results will be obtained if the inflow passageways 38 have a substantially triangular cross-sectional shape, although in certain cases, a substantially square cross-sectional shape of the inflow passageway 38 may be suitable.

In order, on one hand, to enable effective fixation of the intervening fibrous-material layer 37 to one of the other fibrous-material layers 36, for instance with binder, and, in addition, to define efficiently particle-collecting pockets, the intervening filter-material layer 37 may include connecting portions engaging connecting portions of the adjacent filter-material layer so as to cause the connecting portions of the respective layers to form with each other an angle of 45 to 90°, preferably 50 to 70°.

A stable and effective filter pack will be provided in a particularly simple and cost-saving manner, if the layers 36, 37 are rigidly interconnected by means of adhesive strips which close off the outflow passageways 39 at one side of the filter element and the inflow passageways 38 at the opposite side of the filter element.

The filter element 6 may be so devised that the passageways 38, 39 therein extend along the major portion, at least, of the space 2 containing the power unit 5. Further, two filter-units 1, at least, may be associated with each other in such a way that air coming from the inlet end-wall

unit 3 will first flow through one of the filter units then through the other one and from the latter into the space 2 containing the power unit 5. It may be advantageous in certain cases to use different filter units containing filters with different filtering properties, for instance different filtering powers.

The arrangement described by way of example is intended to illustrate the invention in a non-limiting sense. Features described and illustrated can be varied as required without departing from the scope of the invention. Thus, the apparatus may be provided with various accessories, such as handles, for facilitating transport and assembly.

Reference is made to my copending Applications Nos. 39439/78 (Serial No. 1,579,882) and 39440/78 (Serial No. 1,579,883) which have been divided out of this application and which relate respectively to an arrangement for switching on and off at least one power unit adapted to transport a flow of gas through a filter element of a filtering apparatus for separating solid particles from welding gases which are created during welding with an electrically-fed welding unit, and to filter element for separating solid particles from gases and of the type described in the present application.

WHAT I CLAIM IS:—

1. A filtering apparatus for separating solid particles from gases, comprising at least one filter unit disposed between end-wall units and including at least one filter element, and at least one power unit adapted to transport a flow of gas through the filter element of the filter unit, wherein the filter unit comprises a filter container connecting and releasable from the end-wall units, said filter container having open ends and long sides closed by an inner wall and an outer wall whereby said walls together define a filter compartment for the filter element, said inner wall further defines an interior compartment containing the power unit and said outer wall further forms a casing detachably connected to both the end-wall units, and wherein the filter compartment communicates through one of its open ends with one end-wall unit designed as a gas-inlet unit and communicates through its other open end and said inner compartment containing the power unit with the opposite end-wall unit designed as a gas-outlet unit.

2. The apparatus as claimed in Claim 1, wherein the end-wall unit forming the gas-inlet unit comprises an annular passage into which at least one gas supply conduit opens, said gas supply conduit being connected to said end-wall unit through a

quick-coupling device and directing the gas flow through the passage in one direction to rotate so as to create a cyclone effect.

3. The apparatus as claimed in Claim 2, wherein said annular passage is disposed beneath the compartment containing the filter element, is separated from this compartment by a partition having through-flow openings, and made as a detachable member.

4. The apparatus as claimed in Claim 3, wherein said partition carries at least one sealing element and the inner wall of the filter unit sealingly engages said sealing element.

5. The apparatus as claimed in any preceding claim, wherein said inlet end-wall unit has an outer peripheral edge portion adapted to serve as a guiding edge for the outer wall of the filter unit and to retain an annular sealing element sealingly engaging the outer wall.

6. The apparatus as claimed in Claims 4 and 5, wherein said partition has an outer peripheral edge portion which engages the annular sealing element and forms with the guiding edge of said edge portion a groove or recess into which said outer wall projects.

7. The apparatus as claimed in any one of Claims 2 to 6, wherein a wall element forming part of said inlet end-wall unit provides said passage and has an edge portion outside said passage, and in addition defines either directly or indirectly a wall of the inner compartment.

8. The apparatus as claimed in any preceding claim, wherein said power unit is mounted on both end-wall units and is connected to the inlet end-wall unit by at least one clamp screw which can be released to enable the filter unit to be disconnected from the outlet end-wall unit and from the inlet end-wall unit.

9. The apparatus as claimed in any preceding claim, wherein said power unit comprises a casing forming with the filter unit a through-flow space extending along the major portion of the length of the filter unit and communicating at one end thereof with the filter compartment containing the filter element and at the other end thereof with the power unit through at least one inlet opening in said casing.

10. The apparatus as claimed in any one of the preceding claims, wherein said end-wall unit includes a seat having formed therebeneath a space into which heated gas flowing from the power unit is introduced, said space being open to the exterior beneath an outer peripheral edge portion of said seat.

11. The apparatus as claimed in Claim 10, wherein said outlet end-wall unit includes a carrier for the power unit, the

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5 carrier being formed with a protective collar adapted to prevent any water or other fluids or objects penetrating in beneath the seat from proceeding further and entering
10 outlet openings and passing therethrough down to the power unit.

12. The apparatus as claimed in Claim 11, wherein the carrier forms an attachment for at least one control for manually
15 controlling the power unit, and/or an attachment for an operating switch for automatically switching the power unit in and out of operation.

13. The apparatus as claimed in any one of the preceding claims, wherein said
20 outlet end-wall unit comprises an end-wall spaced from the filter element of the filter unit by at least one spacer element which is adapted to prevent any displacement of the filter element in the gas-flow direction, but to allow gas-flow from the compartment containing the filter unit to the compartment containing the power unit.

14. The apparatus as claimed in Claim 13, wherein said end-wall has an outer peripheral edge portion or rim which forms a catch for retaining a sealing element sealingly engaged by the outer wall of the filter unit and also forms a guiding edge for the outer wall.

15. The apparatus as claimed in any one of the preceding claims, wherein at least two filter units are associated with each other in such a way that air coming from the inlet end-wall unit will first flow through one of the filter units and thence through the other and from the latter into the compartment containing the power unit.

16. The apparatus as claimed in Claim 15, wherein the different filter units contain filters with different filtering properties.

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COMPLETE SPECIFICATION

2 SHEETS

This drawing is a reproduction of
the Original on a reduced scale
Sheet 1

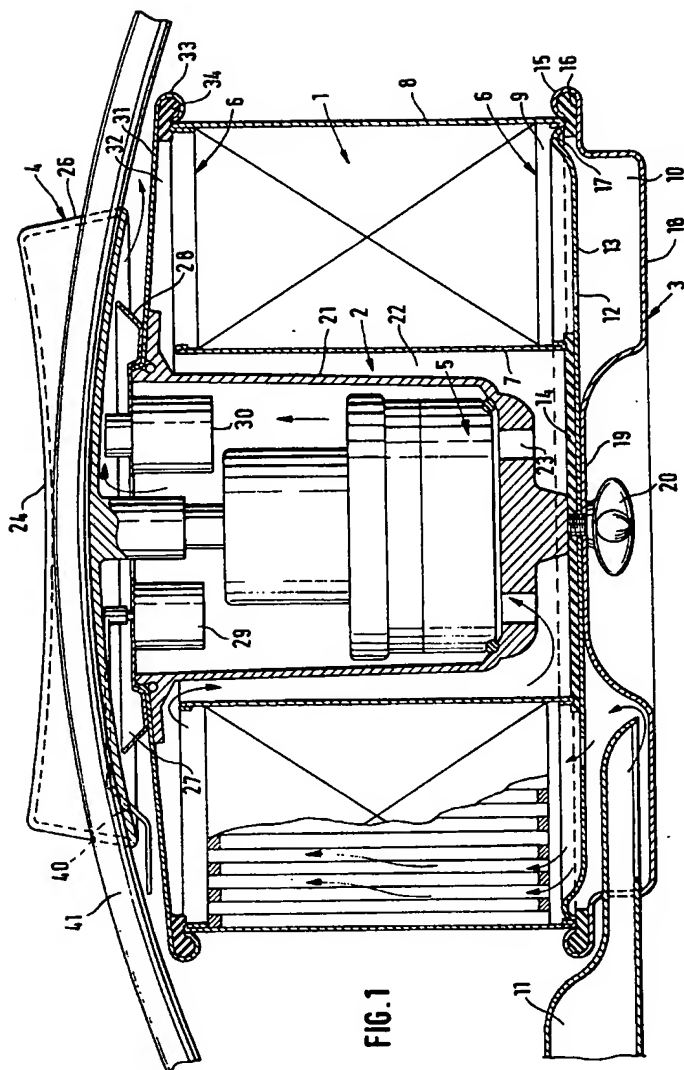


FIG. 1

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COMPLETE SPECIFICATION

2 SHEETS

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Sheet 2*

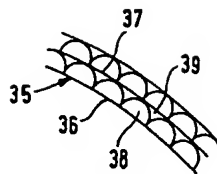


FIG. 2